INTERACTIVE APPARATUSES WITH TACTILEY ENHANCED VISUAL IMAGING CAPABILITY AND RELATED METHODS

FIELD OF THE INVENTION

The present invention relates to the field of interactive apparatus. More specifically, the present invention relates to an interactive apparatus with tactilely enhanced visual imaging capability.

BACKGROUND OF THE INVENTION

Human-machine interface has long been a subject of interest to designers of human operated machinery, particularly for machines or devices intended for "unskilled" novice users, such as personal devices of various kinds, remote controls, palm-sized computing devices (also referred to as personal digital assistants (PDA)), laptop computers, and so forth. Improved ease-of-use, in general, improves user satisfactions.

Increasingly, as a result of advances in microprocessor and other related technologies, more and more personal devices are processor based and multifunctional. For example, today one can acquire a PDA that can also serve as a wireless mobile phone, a MP3 player and so forth.

Typically, the appropriate end user interfaces, i.e. the interfaces for operating one of these devices as a PDA, a wireless mobile phone, or a MP3 player and so forth, are presented on a touch sensitive screen on an as needed basis. A user would interact with the interface by touching the appropriate interface element, a visual image, e.g. a key or button image, or a menu or list item image.

Many of these graphical interfaces are intuitive, and easy-to-use. However, as friendly as these graphical interfaces are, there is no tactile feel to the touching of the key or button image (i.e. a user does not feel the clicking of a real key/button). The same applies to the selection of menu or list items. The lack of tactile feedback is "difficult" or "less satisfying" for some user.

Thus, it is desirable if the user experience may be further enhanced by providing the user with tactile sensations when interacting with at least some of the interface elements.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described by way of exemplary embodiments, but not limitations, illustrated in the accompanying drawings in which like references denote similar elements, and in which:

FIG. **1** illustrates an architectural view of an interactive apparatus of the present invention, in accordance with one embodiment;

FIG. **2** illustrates an exploded perspective view of the tactilely enhanced visual image display of FIG. **1**, in accordance with one embodiment;

FIGS. **3***a*-**3***g* illustrate various example non-persistent input keys that may be dynamically formed using the tactilely enhanced visual images of the present invention, in accordance with a number of embodiments;

FIGS. **3***h*-**3***i* illustrate various example menu and list items that may be dynamically formed using the tactilely enhanced visual images of the present invention, in accordance with a number of embodiments;

FIG. **4** illustrates a tactilely enhanced visual image specification of the present invention and a companion graphics function call to render the tactilely enhanced visual image specified, in accordance with one embodiment;

FIG. **5** illustrates the operational flow of the relevant aspects of a graphics function of the present invention, in accordance with one embodiment;

FIGS. **6-7** illustrate a data structure and a data format suitable for use to store the pixel and piston data of a tactilely enhanced visual image of the present invention, in accordance with one embodiment; and

FIGS. **8***a*-**8***f* illustrate various example devices that may be incorporated with the teachings of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

The present invention includes an interactive apparatus with tactilely enhanced visual imaging capability.

In the following description, various aspects of the present invention will be described. However, it will be apparent to those skilled in the art that the present invention may be practiced with only some or all aspects of the present invention. For purposes of explanation, specific numbers, materials and configurations are set forth in order to provide a thorough understanding of the present invention. However, it will be apparent to one skilled in the art that the present invention may be practiced without the specific details. In other instances, well-known features are omitted or simplified in order not to obscure the present invention.

Parts of the description will be presented in display technology terms, such as pixels, active matrix, pistons and so forth, consistent with the manner commonly employed by those skilled in the art to convey the substance of their work to others skilled in the art. As well understood by those skilled in the art, these quantities take the form of electrical, magnetic, or optical signals capable of being stored, transferred, combined, and otherwise manipulated through electrical and/or optical components of a processor and its subsystems.

Various operations will be described as multiple discrete steps in turn, in a manner that is most helpful in understanding the present invention, however, the order of description should not be construed as to imply that these operations are necessarily order dependent. In particular, these operations need not be performed in the order of presentation.

The phrase "in one embodiment" is used repeatedly. The phrase generally does not refer to the same embodiment, however, it may. The terms "comprising", "having" and "including" are synonymous, unless the context dictates otherwise.

Section headings are merely employed to improve readability, and they are not to be construed to restrict or narrow the present invention.

Overview

FIG. **1** illustrates an architectural view of an interactive apparatus of the present invention, in accordance with one embodiment. As illustrated, interactive apparatus **100** comprises processor **102**, memory **104** and tactilely enhanced visual imaging display **106**, coupled to each other via bus **108**. As will be described in more detail below, tactilely enhanced visual imaging display **106** advantageously enables various tactilely enhanced visual images to be rendered to emulate various input keys/buttons, and/or provide tactilely enhanced menu/list items. These tactilely enhanced emulated input keys/buttons, and/or tactilely enhanced menu/list items provide enhanced user experience,